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Effect of Neem Extract on the Brown Citrus Aphid, *Toxoptera citricida* and it's Parasitoid, *Lysiphlebus testaceipes*

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Figure 1. The brown citrus aphid (*Toxoptera citricida*).

Introduction

The biological activities (such as repellence, anti-feedant, growth regulation and anti-fertility) of the seed extract from the neem tree, *Azadirachta indica* or its most active constituent azadirachtin (AZA) are now known for more than 400 species of insect pests. However, little attention has been paid to its use as an insecticide for control of citrus insect pests. We investigated a commercially available neem extract (Neemix 4.5®, Thermo Trilogy, Columbia, MD) for its biological activities against the brown citrus aphid (BrCA), *Toxoptera citricida* and the parasitic wasp, *Lysiphlebus testaceipes*.

Evaluation Methods and Results

1. Lab bioassays: Five adult aphids or ten 2nd-instar nymphs were respectively transferred to each treated citrus seedling (1.5 to 2.5 cm tall) dipped with the neem extract. Aphid mortality, offspring, and molting were recorded daily for 7 days. The results (Table 1) showed that neem extract at concentrations of 11 to 180 ppm AZA significantly reduced survival rate, longevity, nymph development, and adult reproduction of BrCA. Embryonic mortality just before parturition and failure of ecdysis appeared to be a major cause of adult reproductive failure and death of nymphs due to treatment with neem.



Figure 2. Leaves and fruits of neem tree.

Table 1. Survival, longevity, nymph development, and adult reproduction of BrCA exposed to small citrus seedlings dipped with Neemix 4.5 *

Treat (AZA)	Survival (%) (adult/nymph)						Longevity(d) (adult/nymph)	Avg. no. offspring	Avg. Molts	
	2 days AFT		4 days AFT		7 days AFT					
0ppm	97.5a	100.0a	90.0a	100.0a	42.5a	95.0a	5.7a	6.7a	17.1a	2.9a
11ppm	92.5ab	60.0b	62.5b	33.0b	17.5b	8.0b	4.3b	3.1b	6.0b	0.7b
22ppm	90.0ab	58.0b	50.0bc	30.0b	10.0b	5.0b	4.0b	2.9bc	5.4bc	0.4c
45ppm	92.5ab	51.5b	57.2bc	28.0b	5.0b	0.0b	3.5c	2.8bc	4.6bc	0.4c
90ppm	82.5bc	50.0b	32.5cd	15.0bc	2.5b	0.0b	3.1cd	2.4cd	3.3bc	0.4c
180ppm	77.5c	28.0c	17.5d	8.0c	0.0b	0.0b	2.9d	2.2d	2.5c	0.4c

*Each treatment was replicated eight times (i.e. eight small citrus seedlings). Means within the same column sharing the same letter were not significantly different (P>0.05).

2. Greenhouse tests: Ten adult aphids were transferred to each potted citrus seedling (four months old and about 20 to 25 cm tall) and allowed to reproduce offspring for five days before the neem extract was sprayed on to the potted plants. Number of live aphids (both adult and nymph) was recorded before the foliage application, and 2 days and 7 days after the test. The neem treatments in the greenhouse also resulted in significant reductions in numbers of both adults and nymphs of BrCA (Table 2.).

Table 2. Brown citrus aphid populations before and after foliar application of Neemix 4.5 on potted citrus plants in the greenhouse.*

Treat (AZA)	Mean no. aphids per plant			Population increase index**
	Pre-T	2d AFT	7d AFT	
0ppm	47.9a	130.3a	447.8a	9.50
11ppm	47.2a	35.8b	34.6b	- 0.22
22ppm	48.8a	31.8b	14.8c	- 0.69
45ppm	45.5a	23.3c	5.7c	- 0.83
90ppm	47.4a	11.3cd	2.7c	- 0.95
180ppm	57.0a	2.2d	0.0c	- 1.00

* Each treatment was replicated 20 times (i.e. 20 potted plants). Means within a column sharing the same letter were not significantly different ($P > 0.05$).

** Seven days after the treatments.

3. Impact on *Lysiphlebus testaceipes*: Ten pairs of the adult wasps were confined in a glass vial containing a treated citrus leaf. Observations were made at 8, 24, and 48 hours after exposure to record mortality of the parasitic wasp. Adult emergence rate of the parasitic wasp within mummified hosts was assessed by dipping foliage with aphid mummies in neem extract. The number of the emerged adults was recorded seven days after the treatment. The results (Table 3.) indicated that neem extract had little impact on the survival of adult parasitoids and that parasitoids inside parasitized aphids that were treated with neem emerged in numbers almost equal to the untreated parasitized aphids.



Figure 3. Adult parasitic wasp and mummified aphids.

Table 3. Effect of Neemix 4.5 on the adult survival and emergence of *Lysiphlebus testaceipes*.*

Treat (AZA)	Adult survival rate (%) after the Neemix treatment			Adult emergence rate (%)
	8 hrs	24 hrs	48 hrs	
0ppm	90.8 a	79.2 a	32.5 a	85.5 a
11ppm	89.2 a	80.0 a	32.5 a	83.3 a
45ppm	90.0 a	74.3 ab	30.3 a	79.2 ab
180ppm	82.5 a	69.0 b	27.5 a	73.5 b

* Each treatment of both tests was replicated six times.
Means within a column sharing the same letter were not significantly different ($P > 0.05$)

Conclusions:

Laboratory and greenhouse evaluation of the biological effects of Neemix 4.5 on BrCA and its toxicity to the parasitic wasp of BrCA indicated that the neem extract could be used as an efficient botanical insecticide for control of BrCA. It would be very compatible with an integrated pest management program in citrus ecosystem.

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